

REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1, 3-11, and 13-20 are currently pending in the present application. Claims 2 and 12 have been canceled without prejudice or disclaimer; and Claims 1, 3, 10, 11, 13, and 20 have been amended, by way of the present amendment. Support for the amendments can be found, at least, on pages 20-21, 24-28, and Figures 1-3. No new matter has been added.

In the outstanding Office Action, Claims 10 and 20 were objected to for improper multiple dependency; Claims 3 and 13 were rejected under 35 U.S.C. §112, first paragraph; Claims 1-3, 10-13, and 20 were rejected under 35 U.S.C. §102(b) as anticipated by Bethune et al. (U.S. Pat. No. 6,188,768, hereinafter “Bethune”); Claims 4-8 and 14-18 were rejected under 35 U.S.C. §103(a) as unpatentable over Bethune in view of Negami et al. (U.S. Pat. No. 5,471,545, hereinafter “Negami”); and Claims 9 and 19 were rejected under 35 U.S.C. §103(a) as unpatentable over Bethune in view of Sedlmayr (U.S. Pat. Pub. No. 2004/0114237).

With regard to the objection to Claims 10 and 20 as having improper multiple dependency, Applicants have amended Claims 10 and 20 to depend on Claims 1 and 11, respectively. Accordingly, Applicants respectfully submit that the objection to Claims 1 and 11 be reconsidered and withdrawn.

With regard to the rejection of Claims 3 and 13 under 35 U.S.C. §112, first paragraph, although Applicants do not agree with the rejection, in order to further prosecution Applicants have amended Claims 3 and 13 by deleting at least the feature of “at the same time.” Accordingly, Applicants respectfully submit that the rejection of Claims 3 and 13 under 35 U.S.C. §112, first paragraph, be reconsidered and withdrawn.

Addressing now the rejection of Claims 1-3, 10-13, and 20 under 35 U.S.C. §102(b) as anticipated by Bethune, Applicants respectfully traverse this rejection.

Claim 1 recites, in part,

a transmission path for serving as a transmission medium of light;

a first station having means for emitting time-divided optical pulses divided by a first-time-dividing means into the transmission path and measuring a phase difference between the optical pulses returning from the transmission path; and

a second station having means for reversing traveling directions of the optical pulses, a first phase modulation means for producing the phase difference, corresponding to a value of a random number bit to be transmitted, between the time-divided optical pulses divided by the first-time dividing means, a second means for splitting each entering optical pulse into orthogonally polarized components and a second phase modulation means for producing a 180-degree phase difference between the orthogonally polarized components, means for rotating each polarization direction by 90 degrees, and means for combining the orthogonally polarized components and reemitting the optical pulses into the transmission path.

Claim 11 recites a corresponding method claim.

Bethune describes a system that splits discrete light signals from a laser source into a pair of light pulses that are orthogonally polarized with respect to each other, imparts a phase shift to one or both of the separate pulses during their round trip from the sender to the receiver and back, recombines the phase-shifted pulses at the sender, and then detects from the recombined signal its polarization state, which is representative of the net phase shift imparted by the sender and receiver.¹ In addition, Bethune uses Faraday mirrors to assure that the two pulses travel the same exact path length, and to rotate the polarizations of the pulses back for half of their travel to cancel out all birefringence effects in the optical fibers.²

¹ Bethune: column 2, lines 28-37

² Bethune: column 4, lines 25-30

Furthermore, due to the use of Faraday mirrors, a recombined return pulse has a polarization that is orthogonal to the polarization of the original pulse.³ As shown in Figure 2 of Bethune, the return pulses have their polarizations rotated 90 degrees from their corresponding pulses when they arrive back at the first station, because of the orthogonal polarization rotation.⁴

In contrast, the present invention recognizes that there may be disadvantages to using Faraday mirrors. Accordingly, the claimed invention recites a quantum cryptography system and method capable of maintaining security against disturbance of a polarization state at a transmission path. For example, in the claimed invention, the 90-degree polarization rotation can be accurately implemented with a reversing configuration for preserving the security against the disturbance of the polarization state at the transmission path.⁵

Thus, unlike Bethune, the claimed invention *splits each entering optical pulse into orthogonally polarized components*. Then the first phase modulation means produces a phase difference of one of the orthogonally polarized components, *corresponding to a value of random number bit between the time-divided optical pulses*. Then, a second phase modulation means *produces a 180-degree phase difference between the orthogonally polarized components* and *rotates each polarization direction* of the other orthogonally polarized components *by 90 degrees*. Next, *the orthogonally polarized components* of the first phase modulation means and the second phase modulation means *are combined*, and the optical pulses are then reemitted into the transmission path. As an example, one of the advantages of the claimed invention over Bethune is that a polarized component, resulting from a deviation due to the polarization rotation angle of 90 degrees, is eliminated.⁶

Furthermore, it appears that the outstanding Office Action has confused the two phase modulations (i.e., the first phase modulation means which provides a random number bit

³ Bethune: column 9, lines 11-14

⁴ Bethune: column 6, lines 10-14

⁵ Present Applicant: page 18

⁶ Present Applicant: page 19

between time-divided pulses and the second phase modulation means which produces a 180 degree phase difference between the orthogonally polarized components). However, Applicants note that these are distinct elements that perform different functions.

Accordingly, Bethune does not describe, teach, or suggest a transmission path for serving as a transmission medium of light, a first station having means for emitting time-divided optical pulses divided by a first-time-dividing means into the transmission path and measuring a phase difference between the optical pulses returning from the transmission path, or a second station having means for reversing traveling directions of the optical pulses, a first phase modulation means for producing the phase difference, corresponding to a value of a random number bit to be transmitted, between the time-divided optical pulses divided by the first-time dividing means, a second means for splitting each entering optical pulse into orthogonally polarized components and a second phase modulation means for producing a 180-degree phase difference between the orthogonally polarized components, means for rotating each polarization direction by 90 degrees, and means for combining the orthogonally polarized components and reemitting the optical pulses into the transmission path, as is recited in independent Claim 1.

Furthermore, none of the other cited references (i.e., Negamiu and Sedlmayr), whether taken individually or in combination, discloses or suggests the features of independent Claims 1 and 11.

Accordingly, it is respectfully submitted that independent Claims 1 and 11, and claims depending therefrom, patentably define over Bethune, and the other cited references (i.e., Negamiu and Sedlmayr). Therefore, Applicants respectfully request the rejection of Claims 1 and 11, and claims depending therefrom, be reconsidered and withdrawn.

Consequently, in view of the present amendment and in light of the above discussions, the outstanding grounds for rejection are believed to have been overcome. The application as amended herewith is believed to be in condition for formal allowance. An early and favorable action to that effect is respectfully requested.

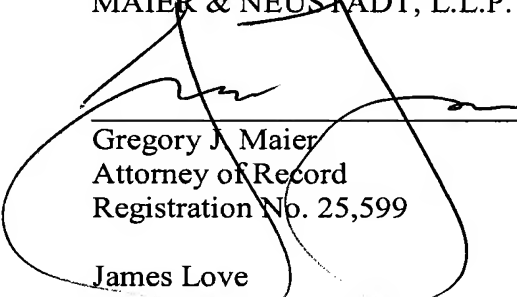
Respectfully submitted,

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